IUTAM Symposium on Hydrodynamic Diffusion of Suspended Particles, 22-25 July 1995, Estes Park, Colorado, USA.

Scientific Committee

R.H. Davis (USA), Chairman
A. Acrivos (USA)
F. Feuillebois (France)
E.J. Hinch (UK)
W. Schneider (Austria)
L. van Wijngaarden (Netherlands)

Short summary of scientific progress achieved

The symposium brought together researchers from academic, government, and private laboratories interested in the interactions of particles in fluids and in granular media. There were 68 participants, including 24 students, currently residing in 12 countries. The participants represented a wide variety of fields, including applied mathematics, chemical engineering, computer science, fluid dynamics, materials science, mechanical engineering, physics, and theoretical and applied mechanics. There were 33 talks and 16 posters presented.

The focus of the symposium was on multiparticle hydrodynamic interactions which lead to fluctuating motion of the particles and resulting particle migration and dispersion or diffusion. Implications of these phenomena were described for sedimentation, fluidization, suspension flows, granular flows, and fiber suspensions. Computer simulation techniques as well as experimental techniques were described. Each session had an invited leadoff talk which overviewed the session topic as well as described the speaker's own related research. Ample time for discussion was included after each talk as well as at the end of each session. The symposium started with a keynote talk on the first evening on "What is so puzzling about hydrodynamic diffusion?", which set the tone for the rest of the meeting by emphasizing both recent advances and unanswered issues. The poster session was also very effective; it had an initial viewing session, followed by two-minute oral presentations on all posters, and then a second viewing session with refreshments provided.

Countries represented and number of participants

Austria	1	Netherlands	2
Brazil	1	Poland	1
Canada	1	Russia	1
France	7	UK	4
Germany	3	USA	43
India	2		
Israel	2	Total	68

Proceedings of the Symposium

An extended abstract booklet was distributed at the symposium. Authors have been invited to submit papers for review and publication together in an issue of the *Physics of Fluids*. An extended report on the key findings of the symposium will be submitted to the *Journal of Fluid Mechanics*.

Financial support

In addition to the sponsorship by IUTAM, additional grants were received from the National Science Foundation, the National Aeronautics and Space Administration, the US Department of Energy, and the Centre National de la Recherche Scientific.

SCIENTIFIC PROGRAMME

Session 1: *Opening Session*

Opening Remarks by Session Chair: R. Davis
D. Koch: What Is So Puzzling About Hydrodynamic Diffusion?

Session 2: *Hydrodynamic Diffusion During Sedimentation and Fluidization*

Opening Remarks by Session Chair: F. Feuillebois
E. Guazzelli: Experiments on Sedimentation: Particle Velocity Fluctuations and Hydrodynamic Self-Diffusion of Sedimenting Non-Brownian Spheres
F. Da Cunha and E. Hinch: Hydrodynamic Dispersion in a Sedimenting Suspension of Non-Brownian Particles
H. Brenner, L. Mondy, J. Abbott, and A. Graham: Dispersion in Concentrated Suspensions
H. Nicolai, Y. Peysson, and E. Guazzelli: Settling of a Heavy Sphere in the Midst of a Suspension of Lighter Spheres
J. Martin, N. Rakotomalala, and D. Salin: Hydrodynamic Dispersion of Non-colloidal Suspensions: Measurement from Einstein's Argument
B. Felderhof: Mean Velocity in a Suspension of Droplets Due to the Thermocapillary Effect
Discussion

Session 3: *Shear-induced Particle Migration and Diffusion*

Opening Remarks by Session Chair: D. Leighton
J. Brady: Shear-induced Diffusion and Particle Migration
D. Leighton: Shear-induced Migration in Colloidal Hard-sphere Suspensions
F. Da Cunha and E. Hinch: The Effect of Surface Roughness in Shearing Suspension
L. Nitsche and J. Nitsche: Collision Properties of Non-simple Bodies and Their Influence on Hydrodynamic Dispersion
Discussion

Session 4: *Applications of Hydrodynamic Diffusion in Suspension Flows*

Opening Remarks by Session Chair: R. Phillips
A. Acrivos: Shear-induced Diffusion and Its Effects on the Rheology of Concentrated Suspensions
U. Schaflinger: Motion of a Sediment Layer Due to a Laminar, Stratified Flow
I. Miskin, L. Elliott, D. Ingham, and P. Hammond: The Shear Induced Diffusion of Particles in a Rectangular Fracture Channel
P. Nott: A Model for Suspension Flow Accounting for Shear-induced Migration
A. Chow, R. Hamlin, and C. Ylitalo: Size Segregation of Concentrated, Bidisperse and Polydisperse Suspensions During Tube Drawing
Discussion

Session 5: *Particle Migration and Segregation in Granular Flows*

Opening Remarks by Session Chair: J. Jenkins
H. Buggisch: On Mixing and Demixing Phenomena in Granular Shear Flow
M. Hunt: The Effect of Particle Diffusion on Heat Transfer for Flows of Granular Materials
J. Jenkins: Fick's Law and Species Separation for a Binary Mixture of Frictionless, Nearly Elastic Spheres
Y. Lan and A. Rosato: Particle Transport in Vibrated Granular Beds
M. Nakagawa, S. Altobelli, A. Caprihan, and E. Fukushima: Unexpected Behavior of Particles in a Horizontal Rotating Cylinder
Discussion

Session 6: *Computer Simulation Techniques for Suspensions and Dispersions*

Opening Remarks by Session Chair: J. Brady
A. Ladd: Numerical Simulations of Hydrodynamic Dispersion
A. Sangani and D. Koch: Sedimentation at Finite Stokes Numbers
G. Ristow: Numerical Predictions for Elastohydrodynamic Collisions
Discussion

Session 7: *Orientational and Configurational Dispersion*

Opening Remarks by Session Chair: E. Hinch
E. Shaqfeh: Orientational and Configurational Diffusion in the Slow Flows of Particles and Polymers
R. Sundararajakumar and D. Koch: The Dynamics of Semi-dilute and Semi-concentrated Fiber Suspensions
O. Harlen and D. Koch: Fibre Suspensions in Dilute Polymer Solutions
A. Szeri: Exploitation of Brownian Motions for the Optimal Control of Fiber Orientation Distributions
Discussion

Poster Session and Reception

J. Blawzdziewicz, F. Feuillebois, N. Lecoq, R. Anthore, and C. Petipas: Theoretical and Experimental Study of Hydrodynamic Interactions Between Several Spheres
V. Kumaran: Diffusion and Coalescence Due to Pair Interactions in a Suspension of Bubbles in Potential Flow
S. Zeng, T. Kerns, A. Zinchenko, and R. Davis: The Nature of Particle Contacts in Sedimentation
M. Loewenberg: Deformation-induced Drop Dispersion
G. Krishnan and D. Leighton: Shear-induced Structure in Bidisperse Suspensions
Y. Wang, A. Acrivos, and R. Mauri: The Longitudinal Shear-induced Gradient Diffusivity of a Monodisperse Dilute Suspension of Spheres
A. Averbakh, A. Shauly, A. Nir, and R. Semiat: Application of Laser-Doppler Anemometry in Highly Concentrated Suspensions
S. McCaffery, L. Elliott, D. Ingham, and A. Unwin: A Newtonian Model for Proppant Transport in an Inclined Channel
Y. Lan and A. Rosato: Self-diffusion in Vibrated Granular Beds
W. Kalthoff, S. Schwarzer, H. Herrmann, and G. Ristow: Application of a Novel Algorithm to Hydrodynamic Diffusion in Sedimenting Systems
S. Altobelli, E. Fukushima, and L. Mondy: Velocity and Fluid Fraction Measurements in Suspensions Flowing Through Abrupt Contractions and Expansions
R. Powell, J. Seymour, M. McCarthy, and K. McCarthy: NMR Imaging Measurements of Average and Fluctuating Velocity Distributions in Sphere Suspension Flow
W. Wolthers, D. van den Ende, M. Duits, and J. Mellema: The Viscosity and Sedimentation of Aggregating Colloidal Dispersions in a Couette Flow
J. Brady and J. Morris: Microstructure in a Strongly-sheared Suspension and Its Impact on Rheology and Self-diffusivity
H.-K. Tsao and D. Koch: Hydrodynamic Diffusion in Sheared, Sedimenting Suspensions at Finite Reynolds Numbers
V.P. Korobeinikov: Unsteady Flows of Two-phase Media in Tubes Due to Local Supply of Mass and Energy

Session 8: *Experimental Techniques for Suspensions and Dispersions*

Opening Remarks by Session Chair: R. Powell
D. Salin and J. Martin: Experimental Techniques for Suspensions and Dispersions
A. Graham, J. Abbott, E. Fukushima, S. Altobelli, N. Phan-Thien, L. Mondy, and T. Stephens: NMR Imaging of Particle Migration in Concentrated Suspensions
M. Lyon and L. Leal: Experimental Studies of the Motion of Concentrated Suspensions in Two-dimensional Channel Flow
A. Shauly, A. Averbakh, R. Semiat, and A. Nir: Shear-induced Migration of Particles in a Flowing Viscous Concentrated Suspension
E. Fukushima, S. Altobelli, A. Caprihan, M. Nakagawa, and L. Wang: NMRI Studies of Granular Flows in a Rotating Horizontal Cylinder
Discussion

R. H. Davis